Program Manager Interviews Anita Jones, Director, Defense Research And Engineering

"Technology is Changing the Way Literally Everything in the Department of Defense is Being Done"

Filling a position previously held by such notables as Secretary of Defense William Perry could certainly be viewed as a tough act to follow. Dr. Anita K. Jones, the current Director of Defense Research and Engineering since June 1993, easily fits the role. Jones, a computer scientist and former member of many defense scientific advisory groups, is spearheading the effort to bring the government's science and technology program into the information age.

On March 28, 1996, *Program Manager* spent an hour with Jones. Whether discussing major DoD senior leadership policies and initiatives, affordability, DoD laboratories, downsizing, or the capabilities of Stealth or Predator, Jones speaks with authority and an amazing grasp of detail. She knows exactly where we [DoD] are in the realm of science and technology as it relates to our nation's defense posture, where we're going, and articulates a clear vision of how we're going to get there.

Dr. Anita K. Jones, Director, Defense Research and Engineering, speaks to *Program Manager's* representatives from her Pentagon office on March 28, 1996.

Throughout the interview, she constantly returned to the theme of supporting the warfighter, and giving him or her that extra edge in battle through the medium of information technology. She also spoke of leaving a legacy for those warfighters in the decades ahead – a legacy that must be built and sustained with today's scientific and technological programs.

We left the interview with the impression that absolutely nothing will deter Jones from using every scientific and technological resource at her disposal to give America's warfighters that extra edge in battle through the medium of information technology. The interview speaks for itself. Let Jones, in her own words, tell you how her office is preparing this nation's defense apparatus to meet the global scientific and technological challenges we face well into the next century.

Program Manager: As Director, Defense Research and Engineering, would you please describe your job for our readers?

Jones: My job is oversight of the science and technology program for the

Mr. Greg Caruth, Director, DSMC Visual Arts and Press, and Ms. Collie Johnson, Managing Editor, Program Manager *Magazine, conducted the interview with Dr. Jones on behalf of the DSMC Press.* Program Manager *gratefully acknowledges the assistance of Ms. Ann Cornett, Confidential Assistant to Dr. Jones, in the coordination and preparation of this interview.*

Photos by Greg Caruth

Department of Defense, and that means the programs that are very long-term research programs, to medium-term, to late-stage technology maturation programs, and they're executed out of the Military Departments and out of the Agencies in the Department of Defense. The people who do the work are in universities, industry, and in our own DoD laboratories.

Program Manager: Would you tell us about your background and experience.

Jones: I'm a computer scientist by training and by trade, and have long worked with the Department of Defense, mainly in an advisory capacity, with the Air Force on the Air Force Scientific Advisory Board; and more recently with the Defense Science Board, which is the senior science advisory board for the Secretary of Defense.

Program Manager: Could you summarize your overarching strategy toward science and technology?

Jones: The primary objective is to develop technology-based options so that our warfighters out in the future have an advantage that is based on technology.

Program Manager: Along with that, how would you characterize the direction taken by this Administration in the area of science and technology and how it has evolved?

Jones: One of the objectives that Secretary Perry set very early on was to sustain DoD's investment in science and technology so that today's leadership provided a legacy for those who come decades after. When Secretary Perry was the Director of Defense Research and Engineering, he started the Stealth Program, and is looked on by many as the father of Stealth. And that was the legacy of the leadership that was there with him at the time, creating the forces that fought in Desert Storm where the F-117 Stealth aircraft, night vision, and precision strike assets performed so well. And now it's our turn to provide a legacy for the military who will follow in later decades.

Program Manager: The Science and Technology Program – how is it generally framed?

Jones: First of all, the Department of Defense has invested in science and technology for decades. And that investment has played an important part in many fields. Some are specific to the military, but some are also important to our economy. For example, information technology – it's a very important set of technologies today. If you look at a major technology-based change in the equipment that we're able to field, it often, in fact usually is dependent on new technology that comes along.

If you again take Stealth as an example, back in the 1970s DoD was investing in basic materials that were later used for radar-absorbing materials. DoD invested in the development of the mathematics used for the codes

Dr. Anita K. Jones

Director, Defense Research and Engineering
Department of Defense

Hon. Anita K. Jones was sworn in as the Director, Defense Research and Engineering on June 1, 1993. She is responsible for management of science and technology programs of the Department of Defense and oversight of in-house laboratories, university research initiatives, and the Advanced Research Projects Agency.

Jones' previous government assignments were advisory. She has been a member of many scientific advisory groups such as the Defense Science Board, Air Force Scientific Advisory Board, National Aeronautics and Space Administration (NASA) Space Science and Applications Advisory Committee's Communications and Information Systems Subcommittee, and various panels of the National Research Council and National Academy of Sciences. She has received the Meritorious Civilian Service Award from the U.S. Air Force.

Her private-sector experience includes serving as Professor and Chair of the Department of Computer Science at the University of Virginia; Vice President and founder of Tartan Laboratories; member of the Board of MITRE Corporation; and member of various academic advisory boards, including the Massachusetts Institute of Technology Lincoln Laboratories Advisory Board. She has published more than 35 technical articles and two books in the area of computer software and systems. She is a member of the National Academy of Engineering and a Fellow of the Association for Computing Machinery.

Jones received her A.B. from Rice University in mathematics. She earned an M.A. from the University of Texas, Austin, in literature, and a Ph.D. in computer science from Carnegie Mellon University. Her husband is Wm. A. Wulf, the AT&T Professor of Engineering and Applied Science at the University of Virginia. They have two daughters, one living in the Seattle, Washington, area and one in Bethesda, Maryland.

needed to design the Stealth signature of an aircraft. Then in the late '70s and early '80s, we were doing later-stage technology development, actually building the radar-absorbing materials and trying to affix them to the outer side of an aircraft, and designing low-radar cross section parts of aircraft such as sensors, engine inlets, and exhausts. It takes decades for such technology to mature if it's really a revolutionary change, as Stealth was. That's the kind of activity that we engage in.

We have a planning process by which we start with the policy guidance of the President, and the vision that's set forth by the Service chiefs and by the Joint Chiefs of Staff. Then in different technology areas and basic research, we plan programs to try to achieve the objectives that they say are needed. Typically, there will be a set of programs, each with a very focused objective. But, when you put them all together, your overall objective is to achieve a major change, such as the design and construction of the Stealth aircraft. Although the content of the program changes over time, the strategic objectives change slowly. The overall objective, as I said at the beginning, is always to find military advantage based on technology, so that then we can package it in the systems we buy, and provide it to the warfighter in a way that he or she can use it.

Today, there have been strategic changes in the way we invest in science and technology. Let me highlight three of those. One is that we are focusing on the reduction of cost as the objective of the science and technology program, where in times past the focus was more on improving performance; for example, flying faster, being more stealthy – those kind of objectives. Well, today we want to go a longer time between maintenance of an aircraft engine – and do so safely! We want the cost of a component, for example an artillery round, to be lower so we can afford to buy more of them with less dollars. These are examples of affordability objectives. If you start early in the science program and technology maturation program, do what is necessary to reduce the eventual costs of systems that are bought, affordability or reduction of costs is an important objective today, where a decade ago it was not a first-rank objective.

Another objective, certainly in Secretary Perry's administration, is to transition technology as rapidly as possible. We have developed a program called Advanced Concept Technology Demonstration where the technologist teams with the warfighter to field for an extended period of time – up to two years – a prototype system or set of systems so that the warfighter can experiment with those systems in field or close-to-field conditions, to see whether it works, and to explore new doctrine or new ways to use that system. We have a number of ACTDs today. One example is an unpiloted air vehicle called the Predator, and it's actually flying in Bosnia today; it is being used for surveillance. It's equipped with sensors, flies over territory, and reports back to its home base. It can autonomously fly itself back to its landing site. And it is a vehicle that gives us long-term surveillance, at a lower cost than a piloted vehicle to do the same job. And, if the commander requires, it can fly into space where you don't want to put a human life at risk.

That's one example of an ACTD that's flying today, in Bosnia. Overall, the ACTDs are an example of technology transition, which as I said, is a strategic objective for the science and technology program.

A third strategic objective is dual use technology. We want to develop technology such that we use commercial technology where we can. And the reason for doing that is the nation as a whole makes a substantive investment through industry, through other agencies' investment, and even through our own, developing technology where the largest market is commercial, not defense. There are economies of scale to be gained if we can buy commercial components. So, if there are places where we can utilize electronics packaged in plastic as opposed to being packaged in ceramic materials, as many of our Military Specification (MILSPEC) components are, we can buy those components much more cheaply.

Second, we will have the advantage of more modern micro-fabrication than if we have to stick with MILSPEC-packaged electronics, developed on an older fabrication line that just builds defense electronics, and is not modernized to be competitive commercially. And so piggybacking on dual use technology, getting the economies of scale that the commercial market engenders, and getting the benefit of commercial investment in that technology gives us an advantage. So, investing in using dual use technology and piggybacking on it wherever we can in the technology program is another strategic change that's part of the technology program. The program really has changed over the last several years, and I've given you three examples. One is setting affordability as an objective; the second is ensuring more rapid technology transition; and the third is exploiting dual use technology.

Program Manager: Is there anything more you'd like to add in this area?

Jones: I'd like to highlight one more thing. Starting this year, to make sure that the technology program is serving the future needs that the warfighter sees coming, we have developed a joint warfighting science and technology plan. We started with a dozen needs stated by the Joint Staff. And we've made sure that we have sets of projects in the technology program that are exploring the technology that could meet those needs. Actually, on the April 4, 1996, we're going to present that plan to the Joint Requirements Oversight Council (JROC) for approval. And this is just one of the things that we've done to make sure that the science and technology program is in every way possible serving the needs of the warfighter.

Program Manager: The next question has to do with the Technology Area Review and Assessment. How do initiatives like this and the Defense Science and Technology Advisory Groups fit into this strategy?

Jones: I've talked to you about the planning process and how we start with the President's science and technology strategy and the joint vision as espoused by General Shalikashvili. I issue a defense science and technology strategy that enunciates strategies like dual use technology, reduced cost, and rapid transition technology. Then we build several plans: the basic research plan, the defense technology plans (one each for a set of 10 technologies), and the Joint Warfighting S&T Plan that I told you we're taking to the JROC. Those build on and interact in a complementary way with the plans that the Services and agencies have for their programs, which they've also documented.

The Technology Review and Assessment (TARA) that you mentioned is a DDR&E initiative in which an outside group of scientists and engineers evaluate the plans for the 10 technology areas and the basic research plan. They advise me. We'll be doing those reviews and assessments in the next two months. For each one we will take a week each with a very small team of people who are, to the greatest extent, drawn from the world outside DoD who are premier scientists and engineers in their own right, to give us their best advice. So it dovetails very nicely with our whole planning and budgeting process.

Program Manager: Are you satisfied with the way in which ACTD projects are being handled thus far?

Jones: They're an important vehicle for rapidly transitioning technology. I think that they are working very well. We are in early stages in many of them because this was a new initiative under Secretary Perry and Secretary Kaminski. The first ones are coming to closure. The Predator UAV that I mentioned earlier is going to move into low rate production, and I think that is a sign of success of that particular ACTD. I am very positive about them, very supportive of them, and I think they are proving to be a good technology transition vehicle.

The overall objective… is always to find military advantage based on technology, so that then we can package it in the systems we buy, and provide it to the warfighter in a way that he or she can use it.

Program Manager: Do you see any problems in keeping this technology "hot" until it can be transitioned into the acquisition system?

Jones: I view the ACTDs actually as an initiative of the technology community because they're being funded with technology funds to more rapidly move them into acquisition. So it's not an issue of keeping the technology hot, but speeding the warfighter evaluation of that technology. We're doing that by working together with the warfighter in the ACTD and giving that warfighter the opportunity to evaluate technology. So we are speeding it up, not just keeping technology on some burner.

Program Manager: How quickly do these become obsolete? Have you seen anything on the drawing board that, by the time it's developed, has been overtaken by something else?

Jones: Typically not. One of the hallmarks of the science and technology program is we evaluate fairly rigorously, both from my office and also in the Military Departments and in the agencies, and adapt programs. So if a technology is not panning out or if there is a new development that makes you want to change what you're doing, we just change because we have the freedom to do so in the technology program. The time that I worry about technology being overtaken is actually when it's outside of the technology development process and it's into acquisition, and our acquisition process then takes so long to actually field it. That's where you see ancient technology continuing to be bought because the program managers are constrained by the rules that they operate under and cannot change as readily as one might like them to be able to change.

Program Manager: In a comparison of the Predator to a manned vehicle, the savings must be astronomical. Do you have any idea of how much you save every time you put a UAV out versus a manned vehicle?

Jones: Each kind of flight craft has a different set of missions, a different set of things it can do and not do. So it's quite difficult to directly and only compare the price tag of two types of aircraft. There is less flexibility in an aircraft when you don't have a pilot.

Program Manager: What size is the Predator, as an example?

Jones: I think the best metric on that is cost. The Predator costs about $10 million, whereas an aircraft that has to be fitted out to hold a pilot and crew – a large surveillance aircraft like a JSTARS – is many times that. As I said earlier, two different types of aircraft are not directly and functionally comparable. For example, the JSTARS has on-board analysis. It has capabilities that you don't have on the Predator because of weight limits. The Predator is a very small aircraft in comparison and can only carry a limited payload.

Program Manager: Dual use technology and affordability are elements of your business strategy. In your experience, can the Department play a useful role in these areas short of assuming responsibility for some form of centralized industrial planning?

Jones: Absolutely. Particularly when we're using technology to reduce the cost of a system. We are for example right now investing in what are called smart structures where you actually embed sensors and activators in structural elements; for example, the main structural beam in a helicopter body, or a structural beam in some ground vehicle. We want the structure to react. We have technology whereby we can embed sensors in metal and composite structures to detect stress, corrosion, and fractures, and actually report out so that you don't do maintenance based on number of hours' use any longer, but based on the actual state of the system. And that could save immense amounts of money. Maintenance is very expensive. If the aircraft skin can report out, "I am corroded over here," then that would be a basis for reducing some of our maintenance costs. And it has nothing to do with centralized industrial planning; it's using technology smartly to reduce the cost: either the cost of the original acquisition or the cost of operation.

Program Manager: Models and simulations, information management, and sensors are all examples of technology serving as a force multiplier. Could you elaborate on potential in each of these areas for meeting future national security needs?

Jones: First, information technologies broadly are the basis of what many people are calling today a revolution in military affairs. If you can deliver highly precise information in a timely way, which may be near real-time or real-time, a commander can change the way a battle is fought. Forces can be managed differently, and there are new options for the delivery of firepower to the theater. And so information technology, broadly speaking, is a catalyst for this revolution in the military.

Modeling and simulation is one kind of information technology as are our sensors, an important piece of which is electronics. Information technology broadly runs through the three areas you highlighted.

Models and simulation, I believe, are going to become ubiquitous. Let me give you a thumbnail sketch of what a simulation is. One can model a physical phenomenon or model the behavior of ground forces in a theater, for training purposes. In both cases, what the computer brings to the simulation – computers underlie simulation – is that it keeps track of a whole lot of details that the human mind is not very good at keeping track of. The human mind is very good at seeing patterns in complex situations and making macro decisions about what's happening in a situation. And so if you can team the human mind that sees the complex patterns and can make the decisions with the computer that keeps track of the details and can portray them in a useful way for the human being, then the human being can achieve more.

Whether it's a scientist looking at a very detailed physical molecular model of corrosion inside an aircraft metallic surface, or whether it's a ground commander who is thinking about a particular tactic for the next day's battle, the computer simulation presents a detailed depiction of what is happening or might happen, and it allows the human being to do what a human being does so well. And that is to get insight – whether it's an engineer looking at a physics model, or a commander who's about to fight a ground battle. Simulation, I believe, is a mind expander. You're going to see it everywhere. Computers have been absorbed into almost all the office and all the warfighting processes and procedures that we have; they just fade into the background. Simulations are going to be absorbed in the same manner. They're going to fade into the background and just be another tool whereby the human being does what the human being wants to do. But the simulation is a support that allows you to do things in a way that without it, the human being cannot do.

Program Manager: A detailed response indeed – you certainly are enthusiastic in speaking about this area...

Jones: Well, it's very exciting! Technology is changing the way literally everything in the Department of Defense is being done. And the faster we harness this technology in a way that the warfighter can use it, the more advantage we have over adversaries that we might meet out in the future.

Program Manager: In the area of basic research, are you satisfied that DoD is adequately financing those areas which will be critical to national security?

Jones: Under Secretary Perry's leadership, we have essentially sustained the basic research budget – the budget to do scientific exploration of ideas that won't come to fruition for a decade or two out. And in a budget reduced about 40 percent over the past decade, that is an appropriate level of funding. It's important that we continue to fund that research, the very longest term endeavors, because we must leave that legacy for those who will come after. There is no way to compress the decade-long time that it takes for a wholly new scientific idea to be developed and eventually captured in systems that we actually hand to the warfighter.

Many people talk about letting industry do it. Industry is very good in a short number of months, e.g., 18 months, to develop a new incremental product that was slightly better than the last product of the same kind that they developed. It's a very different thing to develop a wholly new idea like the laser or like a thermal imager, which is a sensor that can see heat. It takes fielding generation after generation before they really get to be very good. We "owned the night" in Desert Storm because we developed technology that enabled us to "see heat" – which is how you see in the night. That was started two decades ago.

Program Manager: Do you see somewhat of a danger in depending on corporate-funded research to a large extent in the Department of Defense?

Jones: Industry does very little funding of long-term research. They do a great deal more funding of development than we do. As global competition for market share increases, they increasingly invest in the short term.

One of the elements of our acquisition process is that we have something called IR&D or Internal Research and Development. And it's roughly a percentage of our procurement budget. As our procurement budget has gone down, IR&D has gone down, and that was the money that many of the companies that served Defense used to do research. But that's reduced today. So I'm deeply concerned that industry is not investing in research. In fact, it's investing less than it did, partly because our own IR&D is down, but partly because global competition is driving industry to invest more in the short term and less in the long term. And I think you see that in the reports that industrial research laboratories are becoming smaller or are eliminated.

The DoD Laboratories do three things. They do what I'd refer to as science and technology. They also provide science and engineering support for acquisition. And they also solve immediate problems, so called in-Service engineering.

Program Manager: What about our DoD laboratories? Do you think they're going to survive, and also will they be funded for the type of research they want to do?

Jones: The DoD Laboratories do three things. They do what I'd refer to as science and technology. They also provide science and engineering support for acquisition. And they also solve immediate problems, so called in-Service engineering. The laboratories typically combine all three. Different Services do it in different ways. But those are complementary activities. And I think performing them as complementary activities is a good thing to do. Our laboratories are downsizing, and they should downsize. It is necessary as the budget is reduced. Our infrastructure ought to go down. Will the laboratories survive? Absolutely. They'll just be smaller. I hope they will be "leaner and meaner"; and where it's appropriate, that we rely more on industry and do more outsourcing. So I think it's entirely appropriate for the laboratories to reduce in size and rely in more creative ways on industry and on the universities, and do so in a smarter way.

Program Manager: What would be the impact on national defense, in your opinion, if we were to reduce funding for research drastically?

Jones: Catastrophic! I think you wouldn't notice it today. When you say research, it means a very long-term investment. It would not have an effect today. But it would sell short the legacy to those who come after. And I think it would be catastrophic if you reduced it drastically.

Program Manager: Which nation do you believe has the best science and technology?

Jones: I don't think you look to one nation to be the best in everything, not even the United States. I think we are predominant in a number of areas, for example, in software. I think we are clearly predominant in the world in that particular area. We are clearly predominant in the technologies that underlie Stealth. I think the right way to ask that question is to consider technology area by technology area. And different nations will have a particular edge in different areas.

It is difficult to answer the question in terms of sciences because that is so fundamental you don't know what's going to be important until years later. In technology areas you can look at fielded systems, whether they're commercial or defense, and see that one nation is better than another in particular areas. For example, in this country we do not have a robust flat panel display industry. There are many areas in which it is a horse race, and the technology ascendancy can move from one nation to another fairly dramatically. That's one reason why it's very important to sustain an investment and not invest heavily in an area one year, drop it dramatically in another year, destroy your infrastructure, invest the next year, and spend that investment building back the infrastructure, whether it's in industry or laboratories or universities. It's important to continue sustained investment.

Program Manager: How has the disintegration of the Soviet Union affected our science and technology programs? Have we benefited from that change; have we gained anything from them?

Jones: I think it has had a very negative effect on their nations because they cannot fund their scientists and engineers adequately, and we see that to be a problem. For a nation to be stable and strong economically, it must have a cadre of scientists and engineers. It has given us an opportunity in that former Soviet Union countries are willing to work with us in some areas, in where there was no discussion in the past. For example, under the Gore-Chernomyrdin Agreement to do cooperative research and development, Secretary Perry has just signed an agreement to explore the Russian K-36 ejection seat.[1] This is an ejection seat that is a fine example of engineering. It is an ejection seat that we will evaluate. It is one of a number of examples where we have made a cooperative agreement to test prototypes that the Soviets developed.

If you take the long view, both the United States and the former Soviet Union made very large investments in science and technology. Because different people were involved, they made different tradeoffs. So they invested differently. As a result, they may know some things that we don't know. We routinely in a cooperative arrangement like this will evaluate prototypes they built, often over in Russia, and the data that is gained, which is the product of the cooperative agreement, is available to both. And so we learn something, without having made the same investment. And in some cases, that information may prove to be useful. If so, it will be exceedingly cost effective. Even if it's not useful, for a very small evaluation cost you have learned that an avenue of technology exploration was not fruitful, and it's still a good investment because you learn for a very small cost that a candidate investment was not worth making.

Program Manager: You mentioned the flat panel displays. The Japanese dominate that market, and in many other areas too. How do you see that playing against us in the future as we get into a war where we have to depend on them for parts, pieces, and technology to go with the software that we're better at, but takes hardware to support?

Jones: We have systematically done an evaluation of different industrial sectors to ask the question whether the United States had the necessary industrial sector to support national security. In most of those areas, the conclusion has been while industry may be changing in that sector, maybe due to the downturn in the defense budget, there was not a need for DoD to intervene in that industrial sector. A counter example is that we evaluated the submarine construction industry and determined that we needed to continue submarine construction capability, even in the face of not needing the next submarine. The conclusion was that the United States had to keep that industrial capability in place.

Under Secretary Perry's leadership, evaluations have been made, and DoD is not investing unless it deems that it is absolutely necessary, and typically it's not. If you have multiple sources off shore, particularly if those sources are in multiple nations, you may deem that it is not a security risk to forego having industry on shore. Increasingly, a particular company is not national – it is international. And it's very difficult to draw that line of old where "Made in America" was the only acceptable option.

Program Manager: You sound optimistic that many of the people who are afraid that we're not manufacturing in this country anymore, that that may not be as big an issue as the newspapers would lead you to believe.

Jones: I think we've shown by these disciplined studies that you can take a disciplined, analytic approach and answer the question, but you do it industrial sector by industrial sector.

Program Manager: What product of 20th Century science other than the bomb do you think has had the greatest impact on warfare?

Jones: I'm a scientist, so let me look out into the future. I think information technology is the catalyst for a revolution in military affairs. I think it will be wide sweeping in its effects. I think we haven't completely mastered those effects. The effect will be, as it often is, not just in the technology itself, but how warfighting doctrine changes, how the warfighters use this information-based revolution that gives you the ability to know precisely not everything, but much of what you want to know. To precisely locate and navigate forces, and to precisely put destructive power where you want it will change warfare every bit as much as the bomb.

Program Manager: One last question. What's the best advice you ever received that prepared you for the job you now hold?

Jones: When I was a very little girl, I often went fishing with my father – more than I wanted to, because he loved to fish. And the advice he gave me at that time was, "I don't care what you do – but just do something that you like more than fishing." So I did.

ENDNOTE

A photo of a Russian K-36 ejection seat appears on p. 10 of this issue.